Appendix A – **List of Senior Analysts for 2004 Northern Spotted Owl Population Status and Trend Workshop**

Name	Affiliation
Dr. David R. Anderson	Applied Information Company; Fort Collins, CO USGS (retired)
Dr. Robert G. Anthony	U.S. Geological Survey; Corvallis, OR
Dr. Kenneth P. Burnham	U.S. Geological Survey: Fort Collins, CO
Dr. Eric Forsman	U.S Forest Service, Pacific Northwest Research Station; Corvallis, OR
Dr. Alan B. Franklin	Colorado Cooperative Fish and Wildlife Research Unit; Fort Collins, CO
Dr. James E. Hines	U.S. Geological Survey; Laurel, MD
Dr. James Nichols	U.S. Geological Survey; Laurel, MD
Dr. Gail Olson	Oregon State University; Corvallis, OR
Dr. Carl Schwarz	Simon Fraser University; Burnaby, B.C. Canada
Dr. Gary White	Colorado State University; Fort Collins, CO

APPENDIX B - Nearest Neighbor Analysis of Owl Presence Data

A nearest neighbor analysis was performed on owl presence data for each physiographic province to provide an index of spatial distribution for the point data. Preliminary steps included resampling the presence data grids (25-m pixel resolution) into one-mile square pixel resolution grid data sets. This was performed because we were interested in determining the overall distribution patterns of presence data across a large geographic area (the province), and situations where multiple points (separated by hundreds of feet) represented a single owl pair within an individual forest stand (a situation that sometimes occurred with demographic data) would provide too much detail resulting in erroneous distribution statistics.

The analysis was conducted in ArcView Spatial Analyst, using the Animal Movement extension (v2.0) by Hooge and Eichenlaub (2000). The nearest neighbor analysis calculates a series of descriptive statistics of the animal location point patterns. It tests for complete spatial randomness using a selected polygon shapefile. It implements the Clark and Evans (1954) algorithm. The statistic R-value relates how clustered or dispersed points are within the polygon specified (in our case the physiographic province boundary and the habitat capable land within it). An R-value of less than 1 indicates that the points have a tendency towards a clumped (clustered) pattern, an R-value of 1 indicates a random distribution, and an R-value of greater than 1 indicates an organized (uniform) pattern. The range of R-values is 0-2.15, where a value of 0 represents maximum aggregation, and 2.15 represents perfect uniformity.

Table 1. Spatial distribution indices for owl presence data used for modeling habitat.

Physiographic province	n	R-values		z-values	
		Province boundary	Habitat capable lands	Province boundary	Habitat capable lands
Washington Olympic Peninsula	642	0.72	0.76	-7.81	-9.59
Washington Western Cascades	405	0.73	0.81	-6.89	-10.16
Washington Eastern Cascades	712	0.62	0.78	-7.11	-12.98
Oregon Coast Range	1,564	0.74	0.77	-11.52	-13.15
Oregon Western Cascades	2,382	1.03	1.07	4.87	2.01
Oregon Eastern Cascades	549	0.81	0.86	-3.69	-5.09
Oregon Klamath	697	0.90	0.92	-3.84	-4.77
California Cascades	77	0.80	0.84	-2.55	-3.34
California Klamath	893	0.99	1.02	1.25	-0.75
California Coast Range	1,046	0.88	0.92	-4.42	-7.15

The statistics indicate slightly clumpy spatial patterns of presence data in most physiographic provinces. The pattern is randomly distributed in the California Klamath province and slightly uniform in Oregon Western Cascades province. Levels of "clumpiness" diminishes slightly when point patterns are analyzed within the context of habitat-capable land within the province. The following figures show graphic representations of the presence data distributions by state and province (figures B-1 through B-3)

Reference

Clark P. and F.C. Evans. 1954. Distance to the nearest neighbor as a measure of spatial relationship in populations. Ecology 35:445-453

Hooge P.N. and B. Eichenlaub. 2000. Animal movement extension to ArcView, ver. 2.0. Alaska Science Center— Biological Science Office, U.S. Geological Survey, Anchorage, Alaska
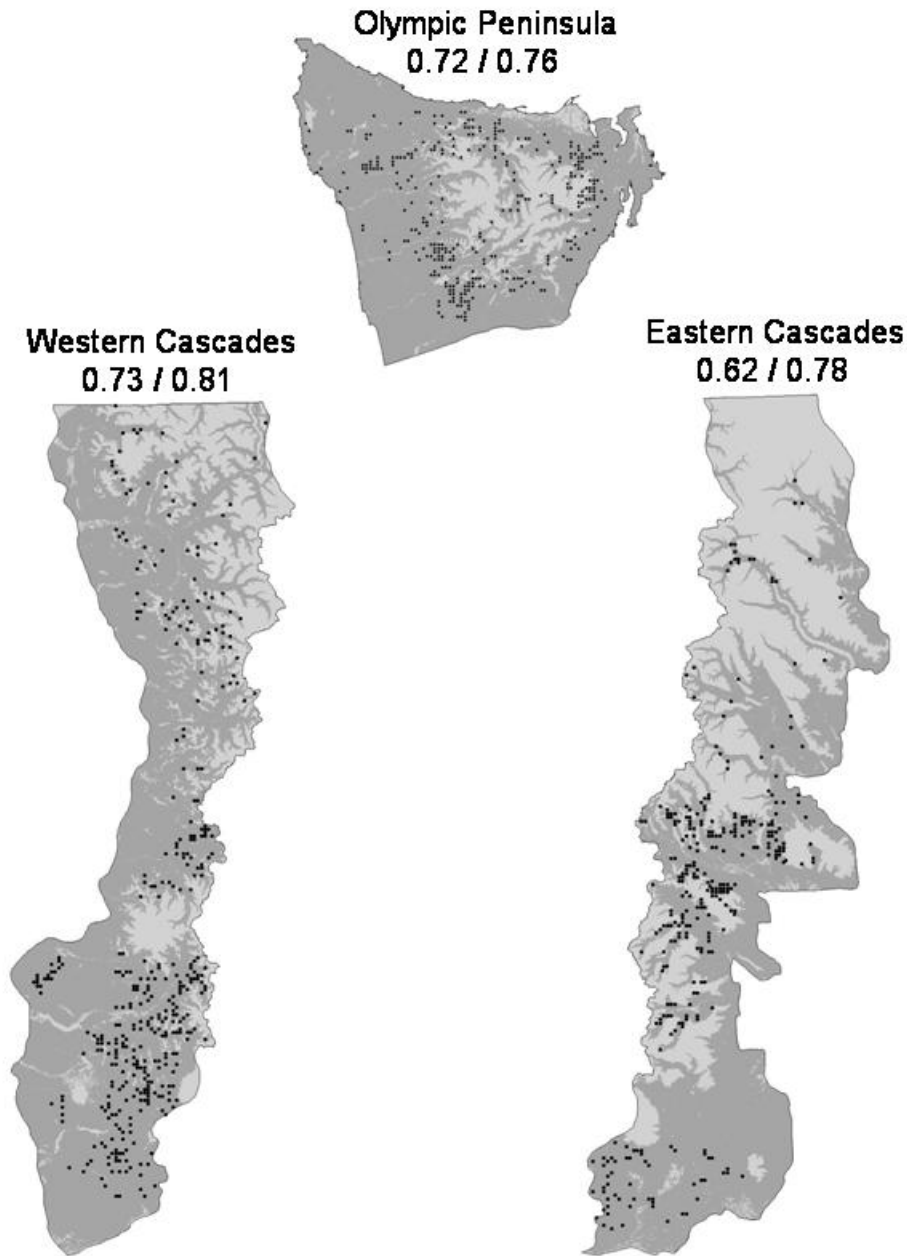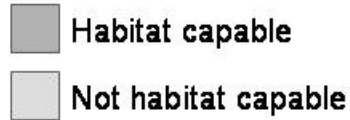
Washington Physiographic Province R-values

Figure B-1. Owl presence data spatial distributions for Washington physiographic provinces. The R-values for both the province and habitat capable lands within it are shown above the province (province/habitat-capable).
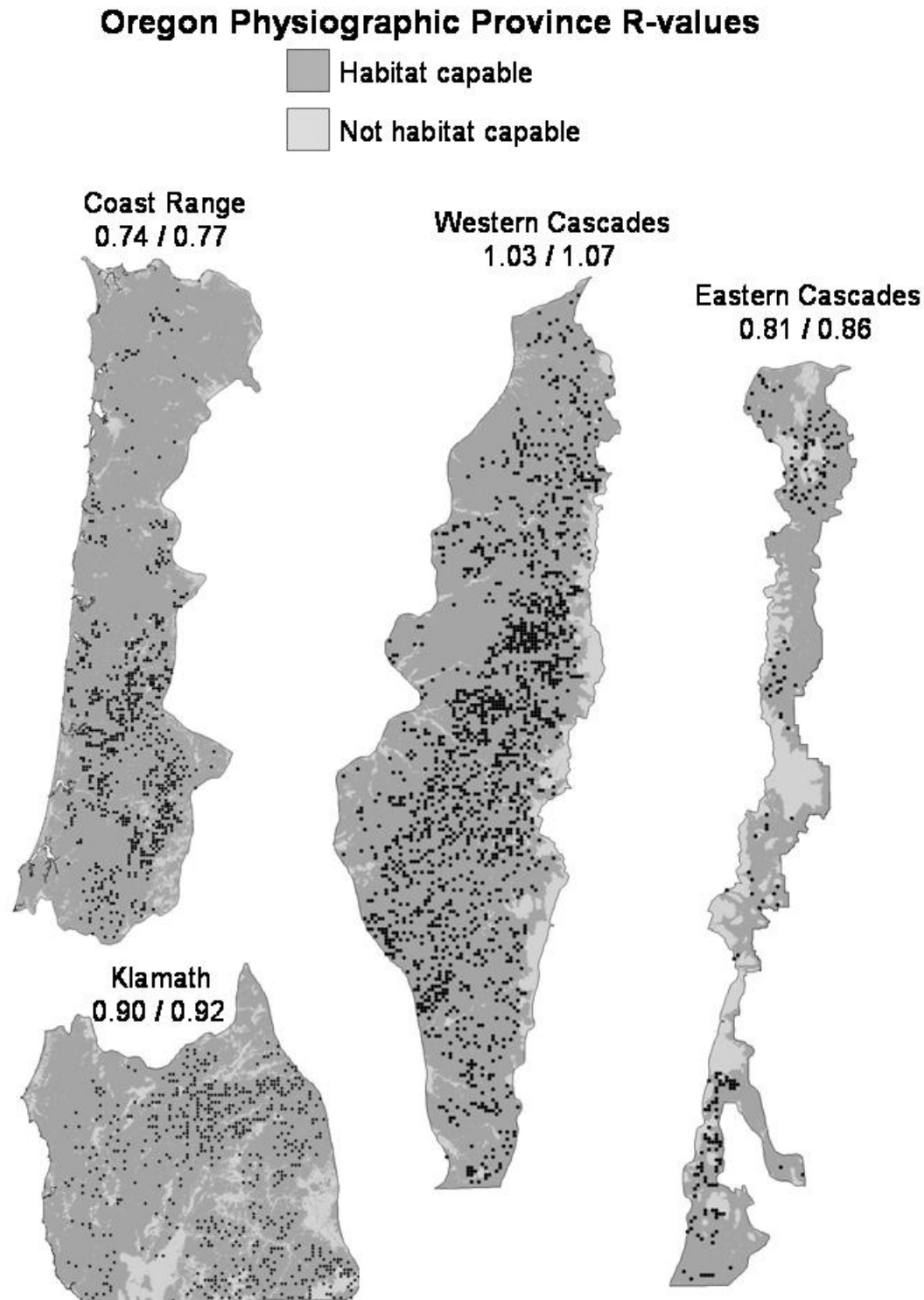
Figure B-2. Owl presence data spatial distributions for Oregon physiographic provinces. The R-values for both the province and habitat capable lands within it are shown above the province (province/habitat-capable).

California Physiographic Province R-values

Habitat capable

Not habitat capable

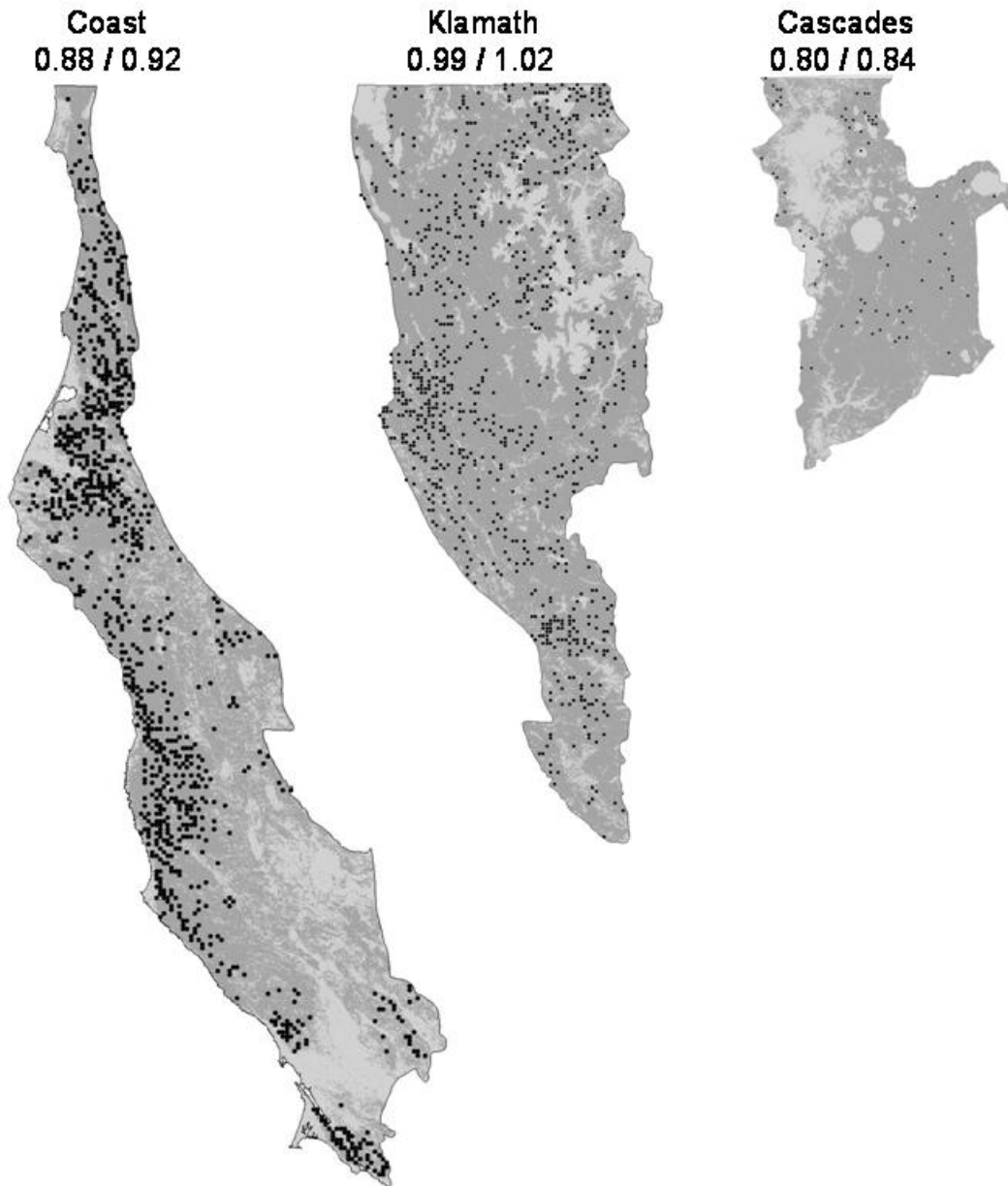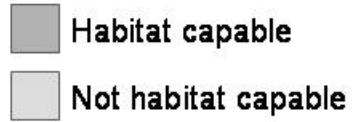| Coast	Klamath	Cascades
0.88 / 0.92	0.99 / 1.02	0.80 / 0.84

Figure B-3. Owl presence data spatial distributions for California physiographic provinces. The R-values for both the province and habitat capable lands within it are shown above the province (province/habitat-capable).

Appendix C. Description and range of values for habitat variables used in BIOMAPPER modeling

Abbreviation	Description	Range of values
QMD	Quadratic mean diameter - diameter at breast height of dominant and codominant trees of average basal area	Continuous integer values in one inch increments from 0 to 75 inches in Oregon and Washington with the exception of the east Cascade and California provinces, where the mean of vegetation strike team size classes were used (e.g., 2, 7, 15….55 inches)
CC	Canopy cover of coniferous trees	Continuous integer values in one percent increments from 0-100% in Oregon and Washington and using the mean of the 10% increments from 0-100% in California (e.g., 5, 15, 25….95%)
QMDCC	Index of the product of conifer tree size and canopy cover [eqn: (QMD x CC) / 10] - A small value indicates small diameter trees or an open canopy and a large value indicates closed canopy of large conifer trees	Continuous integer values from 0 to 750
BDLF	Canopy cover of deciduous trees	Continuous integer values in one percent increments from 0-100% in Oregon and Washington and using the mean of the 10% increments from 0-100% in California (e.g., 5, 15, 25….95%)
VARIETY	An index of stand structure based on the number of vegetation strike team size class categories within a 5x5 window (25 pixels = 4 ac square) - used in Oregon and Washington with IVMP QMD data	Integer values from 1 to 6
STRUCT	Focal mean of discrete structure values (0 if simple or 1 if complex stand structure) within a 5x5 window (25 pixels = 5.5 ac square) - used only in California due to polygon data issue	Continuous integer values from 1 to 100 percent
ELEV	Elevation from USGS digital elevation models	Continuous integer values in meters

Appendix D - Habitat suitability maps for each physiographic province

Figure D-1. Map of spotted owl habitat suitability for habitat-capable lands in the Olympic Peninsula Province in Washington.

Figure D-2. Map of spotted owl habitat suitability for habitat-capable lands in the Western Cascades Province in Washington.

Figure D-3. Map of spotted owl habitat suitability for habitat-capable lands in the Eastern Cascades Province in Washington.

Figure D-4. Map of spotted owl habitat suitability for habitat-capable lands in the Eastern Cascades Province in Oregon.

Figure D-5. Map of spotted owl habitat suitability for habitat-capable lands in the Western Cascades Province in Oregon.

Figure D-6. Map of spotted owl habitat suitability for habitat-capable lands in the Coast Ranges Province in Oregon.

Figure D-7. Map of spotted owl habitat suitability for habitat-capable lands in the Klamath Province in Oregon.

Figure D-8. Map of spotted owl habitat suitability for habitat-capable lands in the Klamath Province in California.
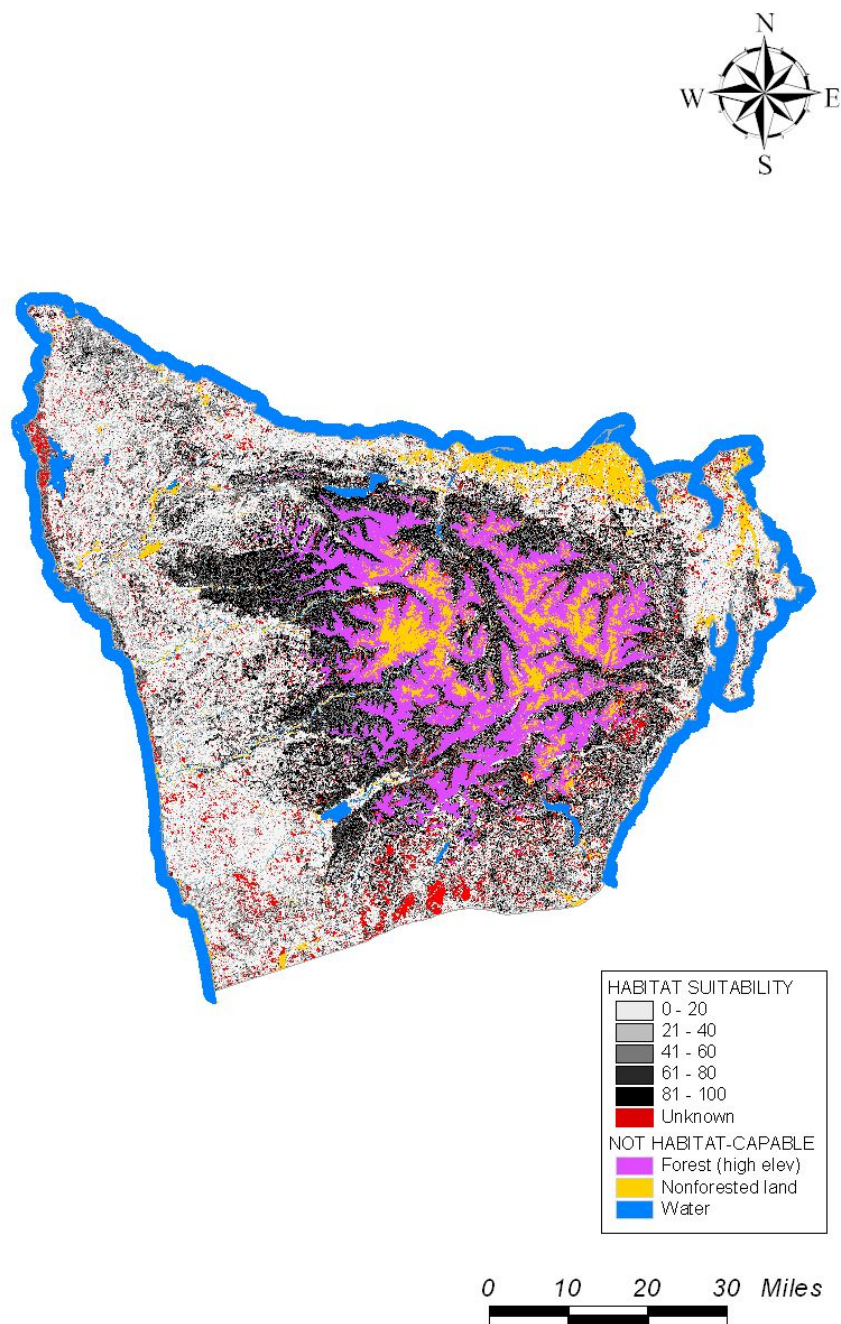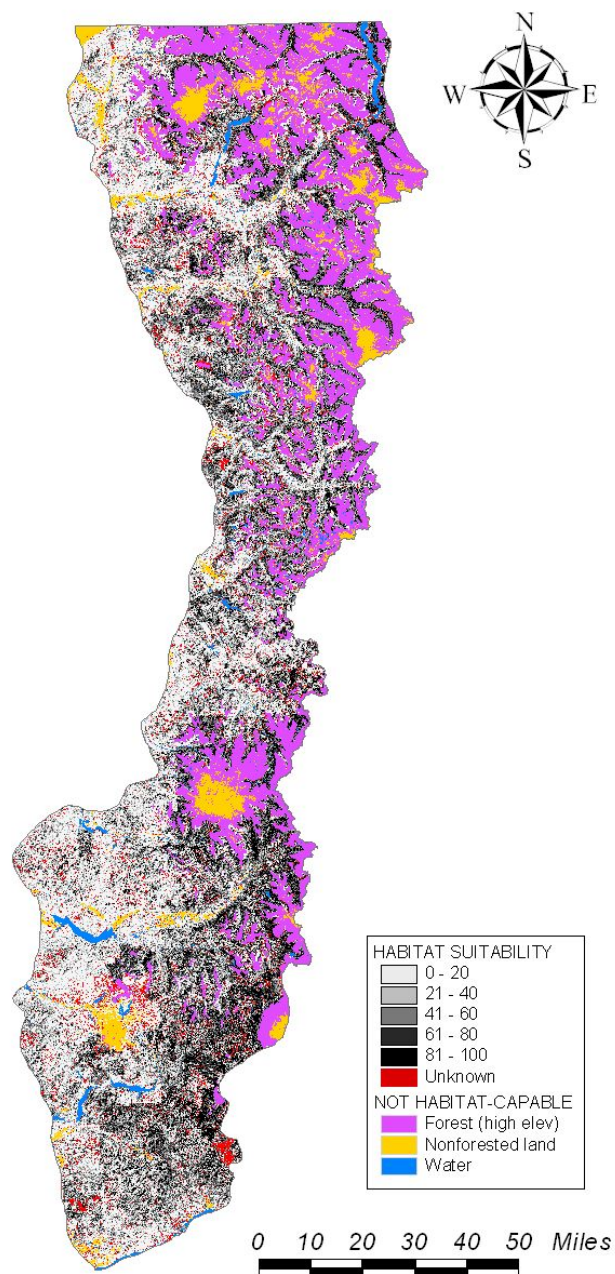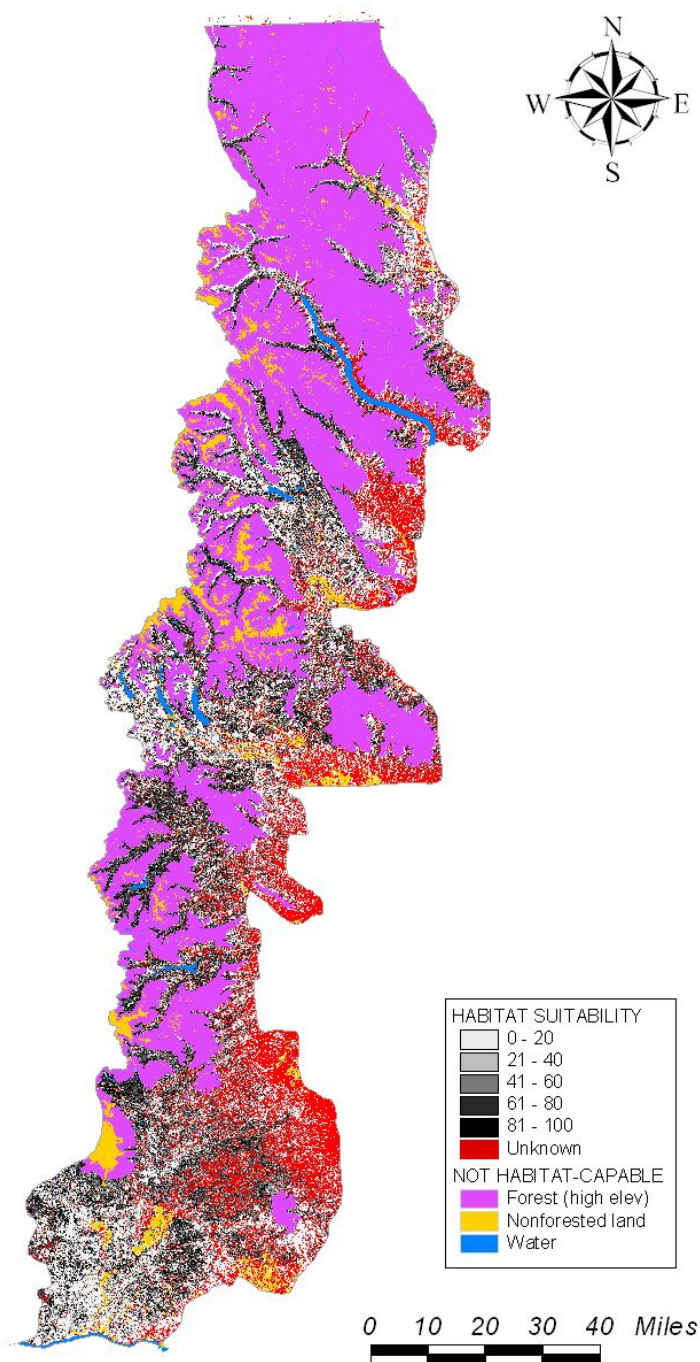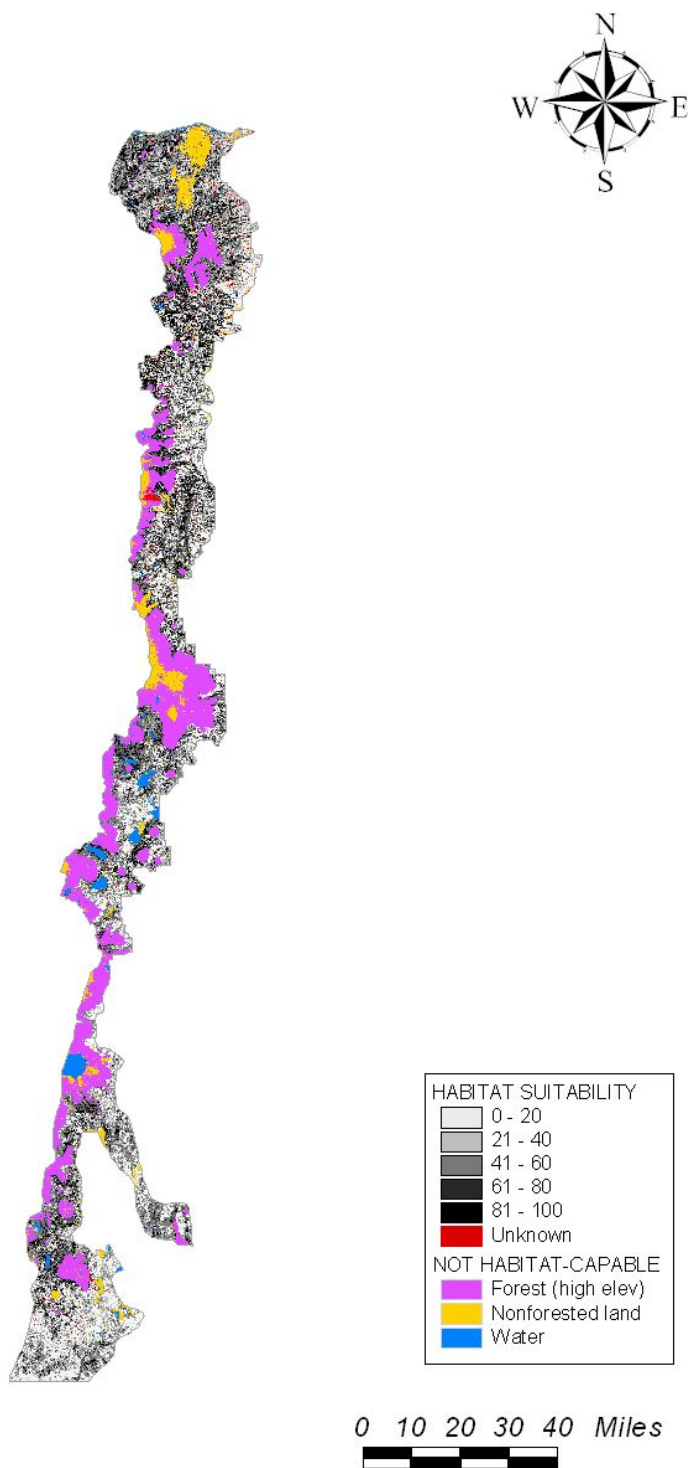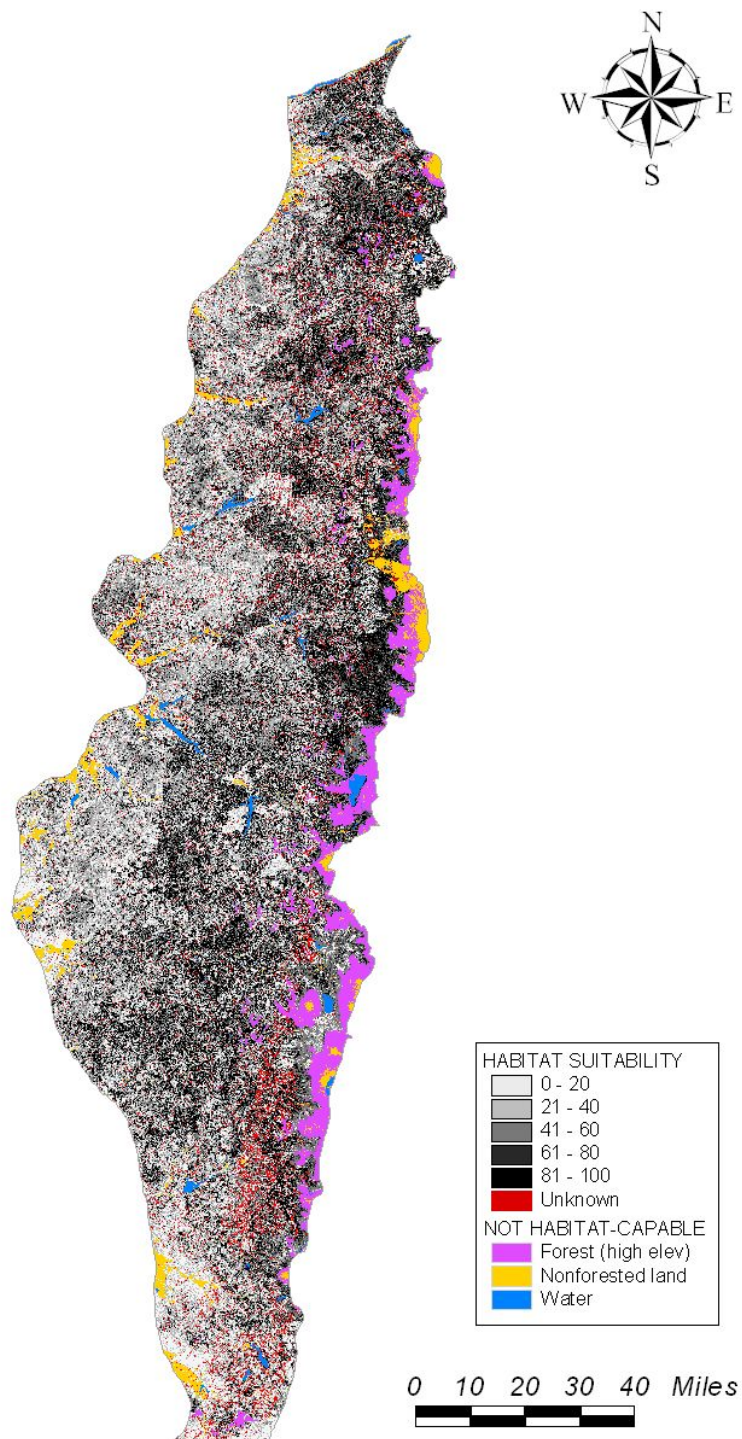
Figure D-9. Map of spotted owl habitat suitability for habitat-capable lands in the Cascades Province in California.

Figure D-10. Map of spotted owl habitat suitability for habitat-capable lands in the Coast Province in California.
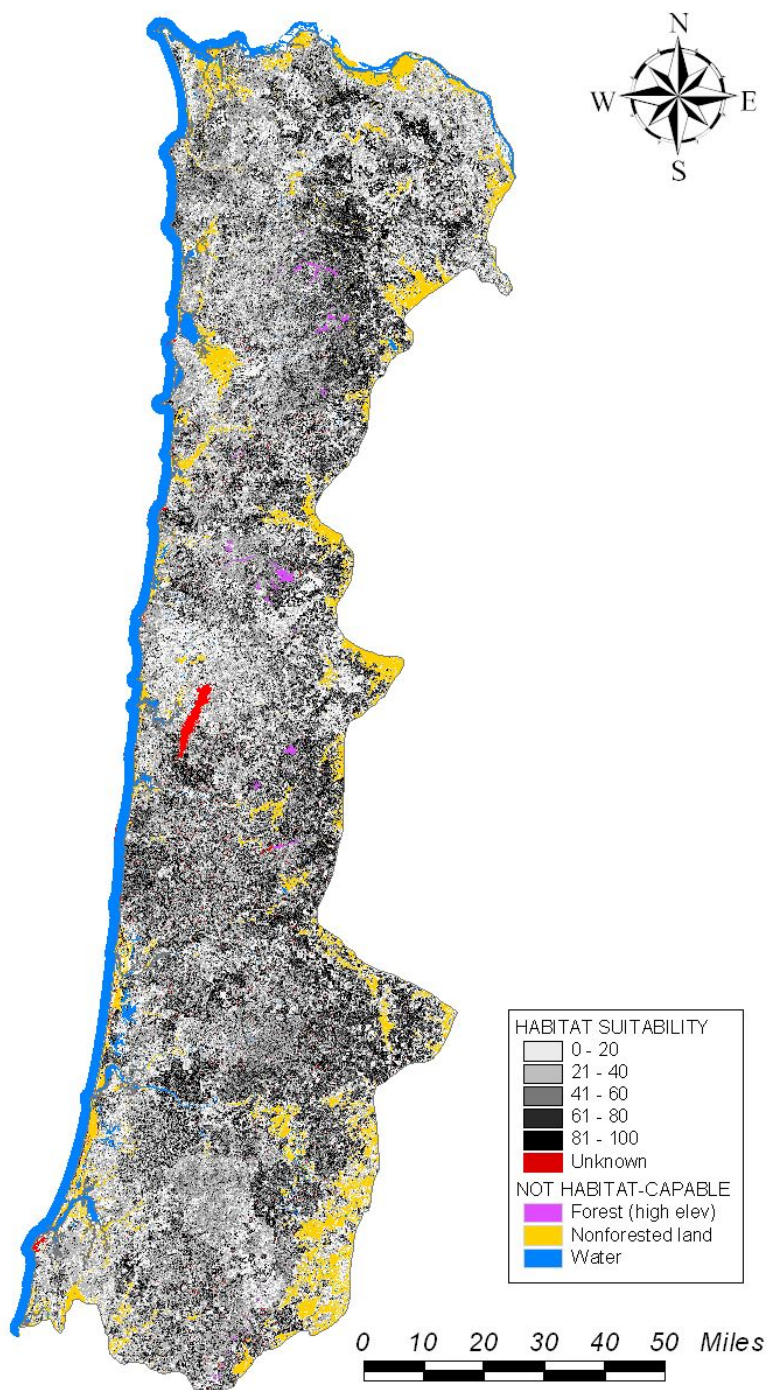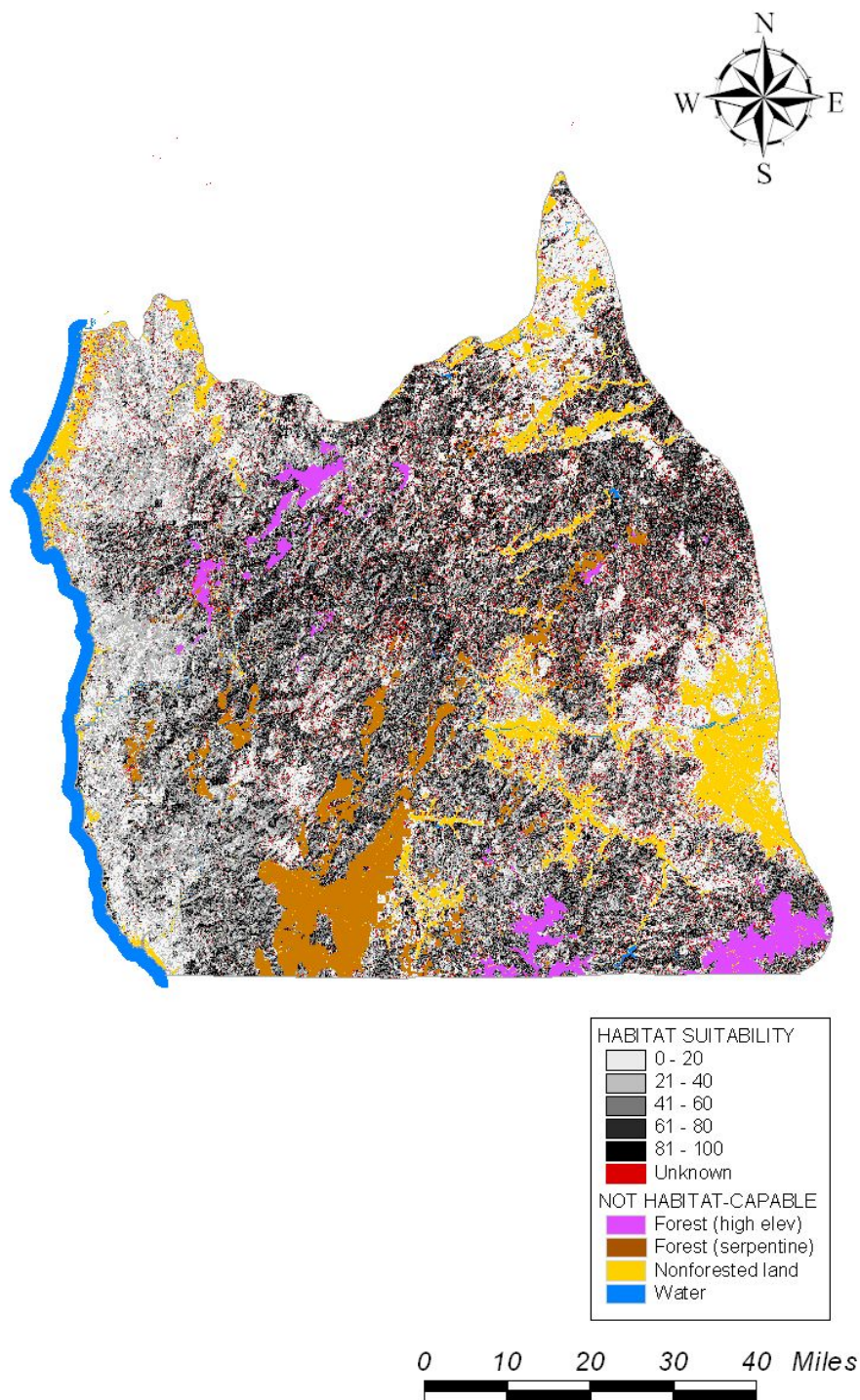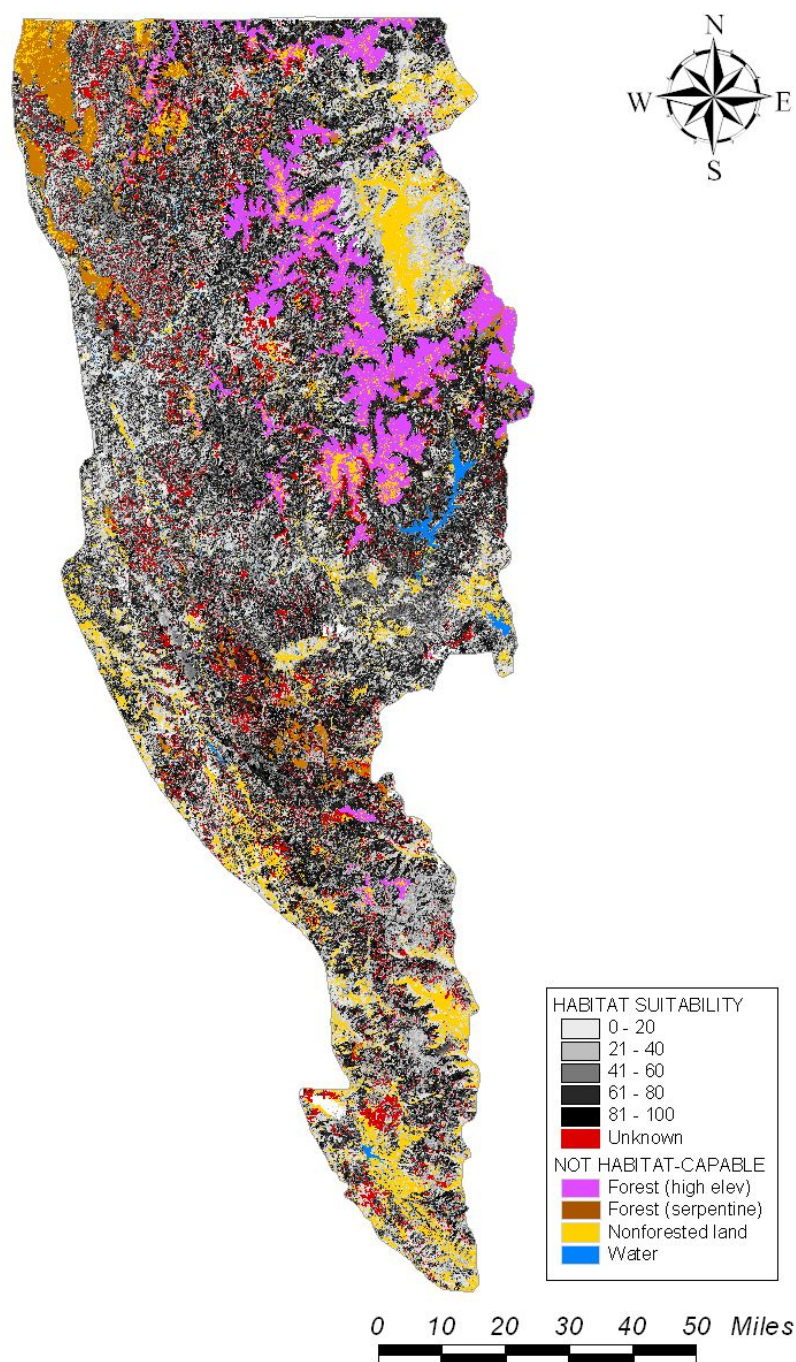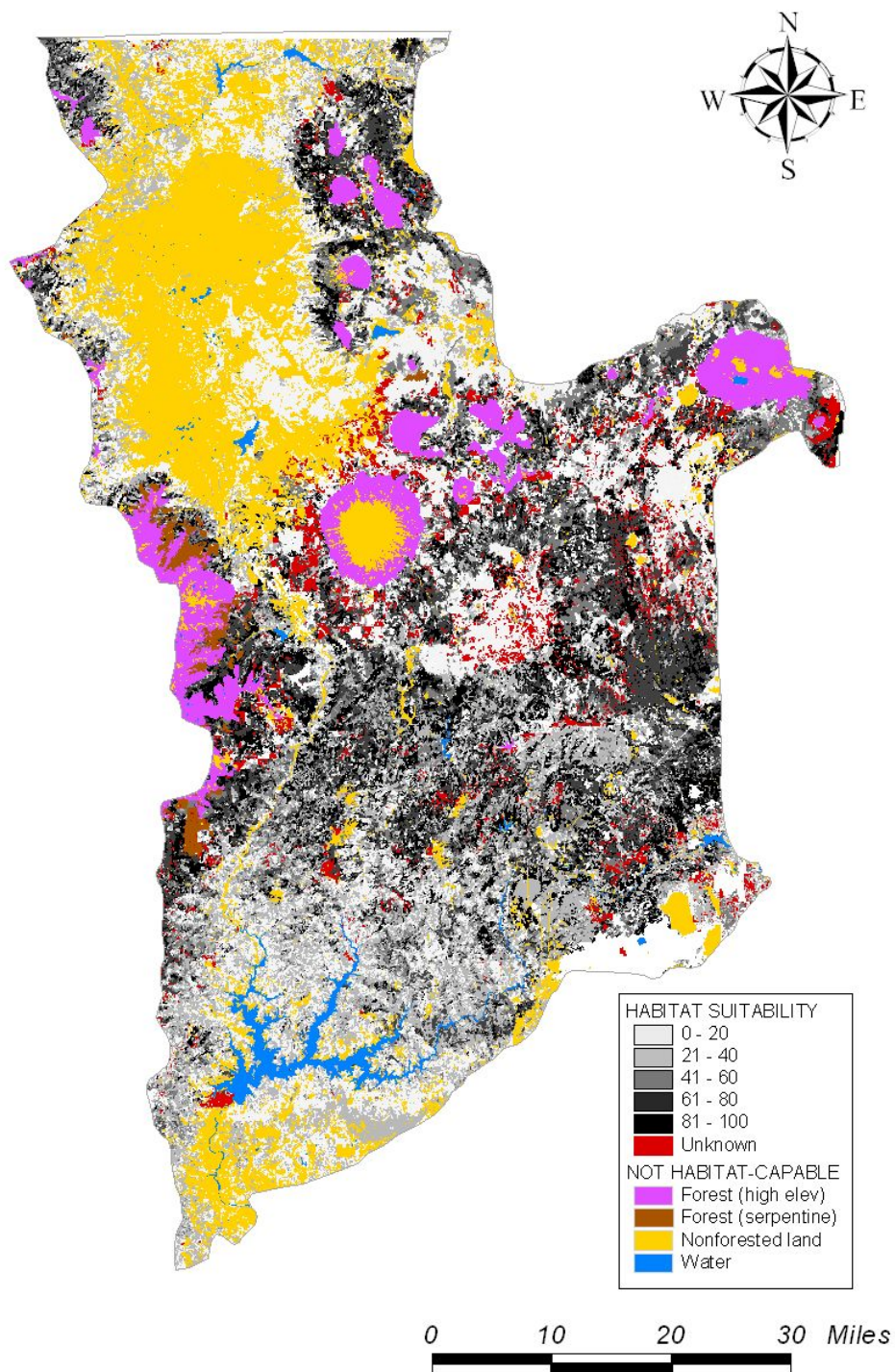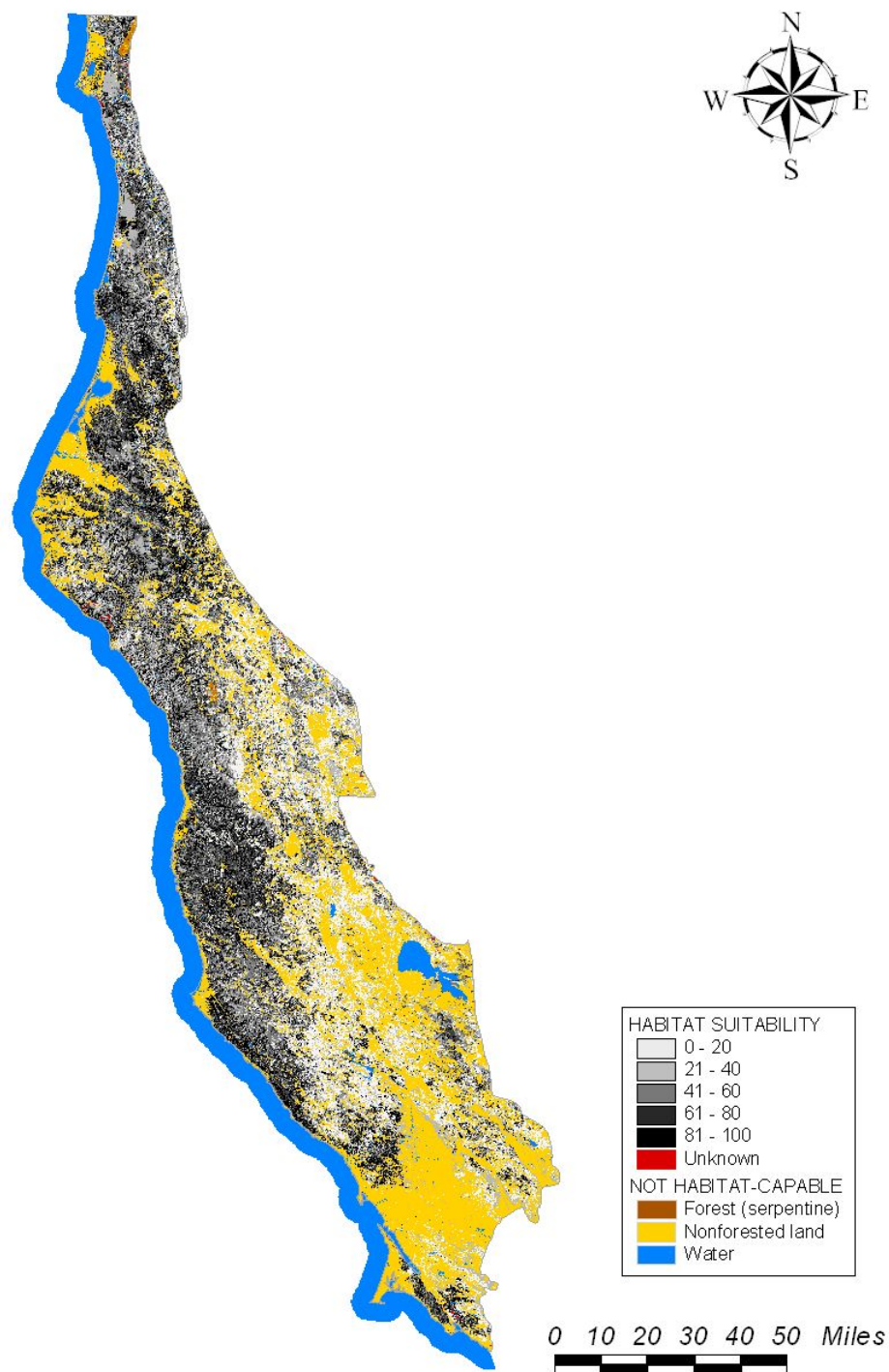
Appendix E – BIOMAPPER habitat model output statistics summary by physiographic province

Figure E-1. BIOMAPPER habitat model output statistics summary for the Olympic Province of Washington.

	n	Acres	Percent Area	
Global	16,631,457	2,568,566	84.75%	*of Total Province Land Area*
Owl Presence	14,257	2,202	0.09%	*of Modeled Area*

TOT PROV AC = 3,030,862

Marginality: 0.838
Specialisation: 2.114
Tolerance (1/S): 0.473

ENFA Results

Factor 1	Factor 2	Factor 3	Factor 4	Factor 5	Factor 6
qmdcc(0.55)	qmdcc(0.76)	qmdcc(0.64)	cc(-0.64)	bdlf(-0.63)	variety(-0.66)
qmd(0.54)	qmd(-0.60)	cc(-0.59)	qmdcc(0.60)	qmdcc(0.48)	bdlf(0.57)
cc(0.38)	cc(-0.23)	qmd(-0.42)	elev(-0.33)	cc(-0.43)	qmdcc(0.45)
variety(0.30)	bdlf(0.02)	elev(0.20)	variety(0.27)	variety(-0.32)	qmd(0.15)
elev(0.29)	variety(0.00)	bdlf(-0.17)	qmd(-0.18)	elev(-0.21)	elev(0.13)
bdlf(-0.29)	elev(0.00)	variety(-0.01)	bdlf(-0.11)	qmd(-0.21)	cc(-0.01)

Factors Used

Factor	Eigen Values	Explains Variation
1	8.725	32.50%
2	10.525	39.30%
3	3.609	13.50%
4	1.895	7.10%
5	1.238	4.60%
		97.0%

Model Indices

Model Quality	Absolute Validation	Contrast Validation
2.10	0.81	0.42
2.00	0.80	0.42
1.90	0.80	0.41
2.00	0.81	0.42
2.20	0.81	0.42
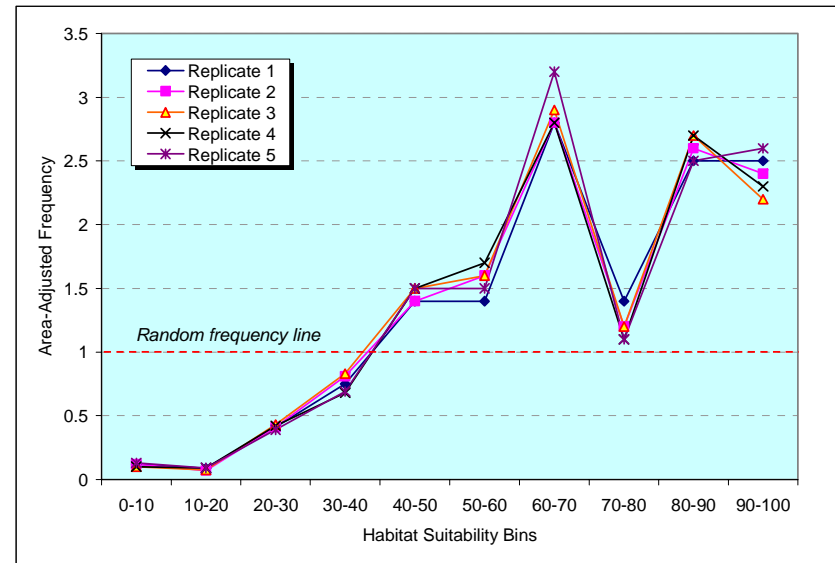
k-fold Cross-Validation

REPLICATE	0-10	10-20	20-30	30-40	40-50	50-60	60-70	70-80	80-90	90-100	Rs	Prob(Rs=0)
1	0.12	0.086	0.41	0.75	1.4	1.4	2.8	1.4	2.5	2.5	0.84	0.0022000
2	0.12	0.07	0.41	0.81	1.4	1.6	2.8	1.2	2.6	2.4	0.84	0.0022000
3	0.099	0.075	0.43	0.83	1.5	1.6	2.9	1.2	2.7	2.2	0.84	0.0022000
4	0.1	0.09	0.42	0.68	1.5	1.7	2.8	1.1	2.7	2.3	0.84	0.0022000
5	0.13	0.09	0.39	0.69	1.5	1.5	3.2	1.1	2.5	2.6	0.84	0.0022000
Mean	0.114	0.082	0.412	0.752	1.460	1.560	2.900	1.200	2.600	2.400		
Rank	9	10	8	7	5	4	1	6	2	3		

Figure E-2. BIOMAPPER habitat model output statistics summary for the Western Cascades Province of Washington.

	n	Acres	Percent Area		
Global	34,568,980	5,338,840	86.81% *of Total Province Land Area*		
Owl Presence	9,931	1,534	0.03% *of Modeled Area*		

TOT PROV AC = 6,149,917

Marginality: 0.791
Specialisation: 2.752
Tolerance (1/S): 0.363

ENFA Results

Factor 1	Factor 2	Factor 3	Factor 4	Factor 5	Factor 6
qmdcc(0.54)	qmdcc(-0.77)	cc(0.66)	cc(0.59)	bdlf(0.77)	variety(0.82)
cc(0.50)	qmd(0.56)	qmdcc(-0.49)	qmd(-0.58)	qmd(0.50)	qmdcc(-0.51)
qmd(0.49)	cc(0.31)	elev(-0.47)	elev(0.38)	cc(0.31)	bdlf(-0.20)
bdlf(-0.45)	bdlf(0.03)	bdlf(0.27)	bdlf(0.32)	elev(0.22)	cc(0.15)
variety(0.12)	elev(0.01)	qmd(0.15)	qmdcc(0.24)	qmdcc(-0.11)	elev(-0.03)
elev(0.01)	variety(0.00)	variety(-0.06)	variety(-0.03)	variety(0.06)	qmd(0.03)

Factors Used

Model Indices

Factor	Eigen Values	Explains Variation	Model Quality	Absolute Validation	Contrast Validation
1	17.319	38.10%	2.10	0.76	0.39
2	17.713	39.00%	2.00	0.78	0.41
3	5.195	11.40%	2.30	0.79	0.42
4	2.684	5.90%	2.30	0.78	0.41
5	1.31	2.90%	2.20	0.76	0.39
		97.3%			

k-fold **Cross-Validation**

REPLICATE	0-10	10-20	20-30	30-40	40-50	50-60	60-70	70-80	80-90	90-100	Rs	Prob(Rs=0)
1	0.055	0.25	0.67	1.2	0.82	2	1.5	1.1	2.6	2.4	0.88	0.0008100
2	0.029	0.2	0.56	1.1	0.9	2.1	1.7	0.94	2.6	2.3	0.88	0.0008100
3	0.038	0.2	0.53	1.2	0.75	1.9	1.9	0.82	2.6	2.6	0.89	0.0005400
4	0.043	0.26	0.58	1.2	0.51	1.8	1.6	0.78	2.7	2.7	0.85	0.0016000
5	0.058	0.2	0.66	1.2	0.85	2	1.5	1	2.5	2.5	0.89	0.0005400
Mean	0.045	0.222	0.600	1.180	0.766	1.960	1.640	0.928	2.600	2.500		
Rank	10	9	8	5	7	3	4	6	1	2		

Figure E-3. BIOMAPPER habitat model output statistics summary for the East Cascades Province of Washington.

	n	Acres	Percent Area		
Global	26,846,530	4,146,183	72.97% *of Total Province Land Area*		
Owl Presence	15,324	2,367	0.06% *of Modeled Area*		

TOT PROV AC = 5,682,385

Marginality: 0.748
Specialisation: 2.036
Tolerance (1/S): 0.491

ENFA Results

Factor 1	Factor 2	Factor 3	Factor 4	Factor 5	Factor 6
qmdcc(0.52)	qmdcc(0.78)	qmdcc(-0.77)	cc(0.62)	qmdcc(0.80)	qmdcc(0.81)
qmd(0.50)	qmd(-0.60)	qmd(0.56)	qmdcc(-0.57)	cc(-0.47)	cc(-0.41)
cc-box(0.49)	cc(-0.16)	cc(0.28)	qmd(0.32)	qmd(-0.36)	qmd(-0.31)
variety(0.30)	elev(0.07)	elev(0.05)	variety(-0.32)	bdlf(-0.10)	bdlf(0.26)
elev(-0.30)	bdlf(0.03)	bdlf(0.02)	bdlf(0.30)	variety(-0.08)	elev(0.08)
bdlf(-0.24)	variety(0.00)	variety(0.01)	elev(0.01)	elev(0.01)	variety(0.07)

Factors Used   **Model Indices**

Factor	Eigen Values	Explains Variation	Model Quality	Absolute Validation	Contrast Validation
1	11.625	46.70%	2.80	0.74	0.37
2	6.136	24.70%	2.80	0.72	0.36
3	3.999	16.10%	2.80	0.74	0.37
4	1.333	5.40%	2.80	0.74	0.37
5	1.008	4.10%	2.80	0.73	0.36
		97.0%			

k-fold **Cross-Validation**

REPLICATE	0-10	10-20	20-30	30-40	40-50	50-60	60-70	70-80	80-90	90-100	Rs	Prob(Rs=0)
1	0.081	0.27	0.71	0.83	0.81	1.3	0.61	3	1.1	3.5	0.82	0.0038000
2	0.065	0.27	0.76	0.84	1	1.5	0.54	2.8	1.2	3.4	0.83	0.0029000
3	0.078	0.31	0.66	0.87	0.77	1.7	0.72	3.1	1.1	3.2	0.87	0.0012000
4	0.062	0.29	0.71	0.86	0.79	1.4	0.67	2.9	1.2	3.4	0.82	0.0038000
5	0.071	0.3	0.71	0.84	0.94	1.4	0.77	3	1.1	3.2	0.88	0.0008100
Mean	0.071	0.288	0.710	0.848	0.862	1.460	0.662	2.960	1.140	3.340		
Rank	10	9	7	6	5	3	8	2	4	1		

Figure E-4. BIOMAPPER habitat model output statistics summary for the Coast Range Province of Oregon.

	n	Acres	Percent Area	
Global	33,876,170	5,231,842	90.32% *of Total Province Land Area*	
Owl Presence	34,073	5,262	0.10% *of Modeled Area*	

TOT PROV AC =   5,792,309

Marginality: 0.916
Specialisation: 2.339
Tolerance (1/S): 0.427

ENFA Results

Factor 1	Factor 2	Factor 3	Factor 4	Factor 5	Factor 6
qmdcc(0.57)	qmdcc(-0.77)	cc(-0.67)	elev(-0.78)	bdlf(0.86)	qmdcc(-0.70)
qmd(0.56)	qmd(0.55)	qmdcc(0.62)	cc(0.47)	qmdcc(0.32)	variety(0.62)
cc(0.40)	cc(0.33)	qmd(-0.33)	qmdcc(-0.36)	cc(-0.28)	cc(0.33)
variety(0.36)	bdlf(0.01)	bdlf(-0.23)	qmd(0.14)	qmd(0.25)	qmd(0.08)
bdlf(-0.27)	variety(0.01)	variety(0.09)	bdlf(0.12)	elev(0.13)	elev(0.00)
elev(0.01)	elev(0.00)	elev(-0.03)	variety(-0.07)	variety(0.06)	bdlf(0.00)

Factors Used

Model Indices

Factor	Eigen Values	Explains Variation	Model Quality	Absolute Validation	Contrast Validation
1	11.482	34.97%	2.70	0.74	0.39
2	11.914	36.29%	2.70	0.75	0.41
3	4.748	14.46%	2.70	0.74	0.40
4	2.795	8.51%	2.80	0.76	0.41
5	1.056	3.22%	2.80	0.74	0.40
		97.5%			

k-fold **Cross-Validation**

REPLICATE	0-10	10-20	20-30	30-40	40-50	50-60	60-70	70-80	80-90	90-100	Rs	Prob(Rs=0)
1	0.038	0.18	0.27	0.57	0.88	1.7	1.6	2.4	2.5	2.7	0.99	0.0000001
2	0.064	0.13	0.29	0.51	0.87	1.7	1.7	2.5	2.4	2.8	0.98	0.0000015
3	0.049	0.15	0.3	0.53	0.87	1.8	1.7	2.4	2.4	2.7	0.99	0.0000001
4	0.041	0.15	0.28	0.54	0.79	1.8	1.7	2.3	2.5	2.8	0.99	0.0000001
5	0.048	0.15	0.31	0.55	0.84	1.7	1.8	2.3	2.4	2.8	1	0.0000000
Mean	0.048	0.152	0.290	0.540	0.850	1.740	1.700	2.380	2.440	2.760		
Rank	10	9	8	7	6	4	5	3	2	1		

Figure E-5. BIOMAPPER habitat model output statistics summary for the Western Cascades Province of Oregon.

	n	Acres	Percent Area	
Global	33,276,259	5,139,192	91.77% *of Total Province Land Area*	
Owl Presence	49,106	7,584	0.15% *of Modeled Area*	

TOT PROV AC =   5,600,270

Marginality: 0.809
Specialisation: 2.344
Tolerance (1/S): 0.427

ENFA Results

Factor 1	Factor 2	Factor 3	Factor 4	Factor 5	Factor 6
qmdcc(0.58)	qmdcc(0.75)	cc(-0.74)	elev(-0.69)	variety(0.71)	bdlf(0.78)
qmd(0.54)	qmd(-0.63)	qmdcc(0.55)	qmdcc(0.50)	qmdcc(-0.56)	cc(0.46)
cc(0.44)	cc(-0.21)	bdlf(-0.31)	cc(-0.42)	qmd(0.33)	qmd(0.39)
bdlf(-0.40)	bdlf(-0.01)	qmd(-0.23)	qmd(-0.23)	cc(0.23)	qmdcc(-0.17)
variety(0.12)	elev(0.00)	variety(0.08)	bdlf(-0.20)	bdlf(0.09)	variety(-0.05)
elev(0.07)	variety(0.00)	elev(0.05)	variety(-0.07)	elev(-0.07)	elev(0.03)

Factors Used

Factor	Eigen Values	Explains Variation
1	9.394	28.50%
2	16.64	50.50%
3	3.18	9.60%
4	1.671	5.10%
5	1.146	3.50%
		97.2%

Model Indices

Model Quality	Absolute Validation	Contrast Validation
2.10	0.82	0.41
2.00	0.81	0.40
1.80	0.81	0.41
2.00	0.81	0.41
1.90	0.81	0.41
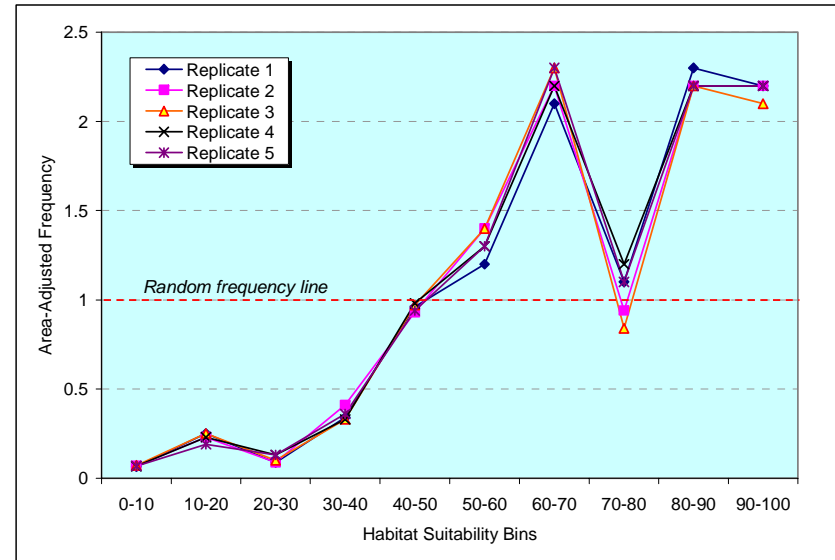
k-fold Cross-Validation

REPLICATE	0-10	10-20	20-30	30-40	40-50	50-60	60-70	70-80	80-90	90-100	Rs	Prob(Rs=0)
1	0.065	0.25	0.088	0.34	0.96	1.2	2.1	1.1	2.3	2.2	0.94	0.0000550
2	0.069	0.23	0.089	0.41	0.93	1.4	2.2	0.94	2.2	2.2	0.94	0.0000550
3	0.072	0.25	0.1	0.33	0.97	1.4	2.3	0.84	2.2	2.1	0.84	0.0022000
4	0.067	0.23	0.13	0.33	0.98	1.3	2.2	1.2	2.2	2.2	0.9	0.0003400
5	0.068	0.19	0.13	0.36	0.94	1.3	2.3	1.1	2.2	2.2	0.88	0.0008100
Mean	0.068	0.230	0.107	0.354	0.956	1.320	2.220	1.036	2.220	2.180		
Rank	10	8	9	7	6	4	1	5	1	3		

Figure E-6. BIOMAPPER habitat model output statistics summary for the Eastern Cascades Province of Oregon.

	n	Acres	Percent Area		
Global	19,806,907	3,058,983	90.98% *of Total Province Land Area*		
Owl Presence	12,955	2,001	0.07% *of Modeled Area*		

TOT PROV AC =   3,362,271

Marginality: 0.849
Specialisation: 2.322
Tolerance (1/S): 0.431

ENFA Results

Factor 1	Factor 2	Factor 3	Factor 4	Factor 5	Factor 6
qmdcc(0.58)	qmdcc(0.77)	cc(-0.76)	variety(0.92)	bdlf(0.87)	cc(-0.69)
qmd(0.52)	qmd(-0.53)	qmdcc(0.52)	qmdcc(-0.24)	qmdcc(0.43)	qmdcc(0.64)
cc(0.45)	cc(-0.37)	bdlf(-0.29)	bdlf(-0.19)	cc(0.20)	elev(0.24)
bdlf(-0.40)	bdlf(0.02)	qmd(-0.20)	qmd(-0.18)	variety(0.15)	qmd(-0.17)
elev(-0.15)	elev(0.00)	elev(-0.17)	cc-box(0.13)	elev(-0.04)	bdlf(-0.16)
variety(0.11)	variety(0.00)	variety(0.01)	elev(0.04)	qmd(-0.02)	variety(0.01)

Factors Used   **Model Indices**

Factor	Eigen Values	Explains Variation	Model Quality	Absolute Validation	Contrast Validation
1	5.935	18.30%	2.30	0.84	0.39
2	20.189	62.40%	2.10	0.82	0.37
3	2.989	9.20%	2.30	0.84	0.38
4	1.241	3.80%	2.10	0.84	0.38
5	1.209	3.70%	2.20	0.82	0.37
		97.4%			

k-fold Cross-Validation

REPLICATE	0-10	10-20	20-30	30-40	40-50	50-60	60-70	70-80	80-90	90-100	Rs	Prob(Rs=0)
1	0.082	0.11	0.3	0.17	0.61	1	2.1	1.3	2.8	2.4	0.96	0.0000073
2	0.063	0.22	0.19	0.21	0.7	1.1	2.1	1.4	2.7	2.2	0.94	0.0000550
3	0.066	0.16	0.42	0.17	0.64	1	2	1.4	2.7	2.4	0.96	0.0000073
4	0.089	0.25	0.31	0.14	0.62	1.1	2.2	1.2	2.8	2.2	0.94	0.0000550
5	0.058	0.13	0.38	0.24	0.71	1.1	1.9	1.3	2.7	2.3	0.96	0.0000073
Mean	0.072	0.174	0.320	0.186	0.656	1.060	2.060	1.320	2.740	2.300		
Rank	10	9	7	8	6	5	3	4	1	2		

Figure E-7. BIOMAPPER habitat model output statistics summary for the Klamath Province of Oregon.

	n	**Acres**	**Percent Area**	
Global	22,518,397	3,477,746	86.90%	*of Total Province Land Area*
Owl Presence	16,572	2,559	0.07%	*of Modeled Area*

TOT PROV AC = 4,001,997

Marginality: 0.963
Specialisation: 2.879
Tolerance (1/S): 0.347

ENFA Results

| Factor 1	Factor 2	Factor 3	Factor 4	Factor 5	Factor 6
qmdcc(0.54)	qmdcc(-0.78)	cc(0.73)	elev(0.87)	qmdcc(-0.66)	qmdcc(0.72)
qmd(0.51)	qmd(0.52)	qmdcc(-0.57)	bdlf(0.46)	cc(0.53)	variety(-0.60)
cc(0.46)	cc(0.35)	bdlf(0.27)	variety(0.12)	bdlf(-0.42)	cc(-0.31)
bdlf(-0.39)	bdlf(0.02)	qmd(0.23)	qmdcc(0.08)	variety(-0.27)	bdlf(0.12)
variety(0.26)	variety(0.01)	variety(-0.13)	cc(-0.08)	elev(0.20)	qmd(-0.10)
elev(0.13)	elev(0.00)	elev(-0.03)	qmd(0.05)	qmd(-0.01)	elev(0.02)

Factors Used

Factor	Eigen Values	Explains Variation
1	19.206	38.60%
2	23.356	47.00%
3	3.155	6.30%
4	1.654	3.30%
5	1.295	2.60%
		97.8%

Model Indices

Model Quality	Absolute Validation	Contrast Validation
3.00	0.80	0.44
3.10	0.79	0.43
3.10	0.79	0.43
3.10	0.79	0.43
3.00	0.81	0.44
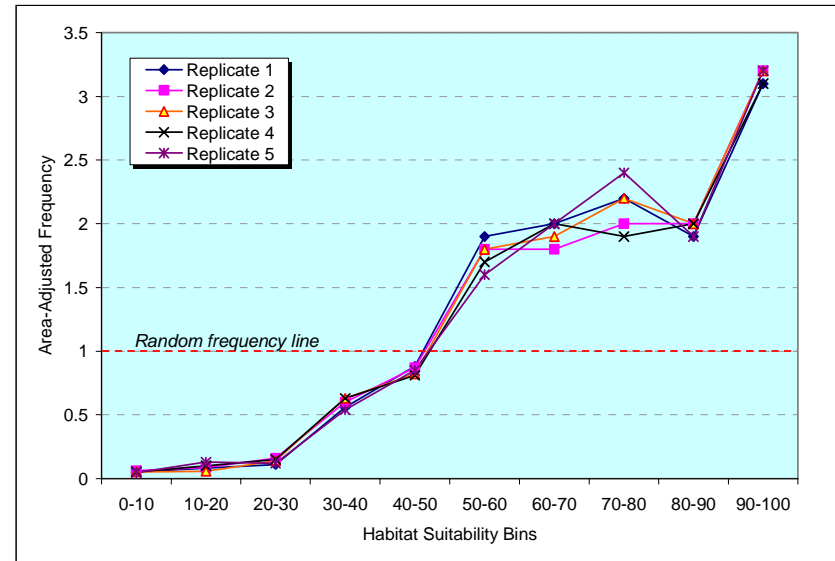
***k-fold* Cross-Validation**

REPLICATE	0-10	10-20	20-30	30-40	40-50	50-60	60-70	70-80	80-90	90-100	Rs	Prob(Rs=0)
1	0.051	0.081	0.11	0.56	0.88	1.9	2	2.2	1.9	3.1	0.96	0.0000073
2	0.061	0.087	0.16	0.6	0.87	1.8	1.8	2	2	3.2	0.98	0.0000015
3	0.053	0.056	0.14	0.63	0.82	1.8	1.9	2.2	2	3.2	0.99	0.0000001
4	0.053	0.1	0.15	0.63	0.81	1.7	2	1.9	2	3.1	0.99	0.0000001
5	0.046	0.13	0.12	0.54	0.85	1.6	2	2.4	1.9	3.2	0.95	0.0000230
Mean	0.053	0.091	0.136	0.592	0.846	1.760	1.940	2.140	1.960	3.160		
Rank	10	9	8	7	6	5	4	2	3	1		

Figure E-8. BIOMAPPER habitat model output statistics **summary for the Cascades Province of California.**

	n	Acres	Percent Area		
Global	8,331,740	1,852,929	74.06% *of Total Province Land Area*		
Owl Presence	1,890	420	0.02% *of Modeled Area*		

TOT PROV AC =   2,502,094

Marginality: 0.842
Specialisation: 1.795
Tolerance (1/S): 0.557

ENFA Results

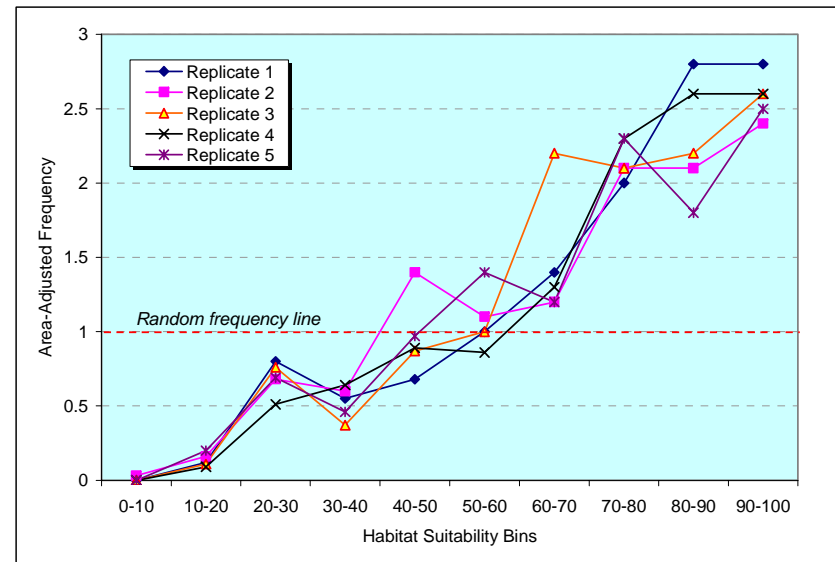| Factor 1	Factor 2	Factor 3	Factor 4	Factor 5	Factor 6
qmdcc(0.53)	qmdcc(-0.77)	qmdcc(0.79)	bdlf(0.69)	struct(-0.63)	qmdcc(0.73)
cc(0.50)	cc(0.47)	qmd(-0.41)	elev(0.53)	cc(0.59)	cc(-0.67)
qmd(0.43)	qmd(0.42)	cc(-0.37)	cc(0.42)	qmd(0.35)	struct(-0.12)
struct(0.41)	bdlf(0.02)	bdlf(0.24)	struct(-0.24)	elev(-0.27)	qmd(-0.04)
bdlf(-0.27)	struct(0.01)	elev(-0.12)	qmdcc(-0.09)	qmdcc(-0.22)	elev(0.04)
elev(0.19)	elev(-0.01)	struct(0.06)	qmd(0.07)	bdlf(0.06)	bdlf(0.00)

Factors Used

Model Indices

Factor	Eigen Values	Explains Variation	Model Quality	Absolute Validation	Contrast Validation
1	4.768	24.70%	2.70	0.76	0.38
2	8.66	44.80%	2.30	0.70	0.33
3	2.347	12.10%	2.50	0.78	0.40
4	1.494	7.70%	2.60	0.77	0.39
5	1.221	6.30%	2.40	0.74	0.37
		95.6%			

k-fold **Cross-Validation**

REPLICATE	0-10	10-20	20-30	30-40	40-50	50-60	60-70	70-80	80-90	90-100	Rs	Prob(Rs=0)
1	0	0.12	0.8	0.55	0.68	1	1.4	2	2.8	2.8	0.96	0.0000073
2	0.03	0.16	0.68	0.6	1.4	1.1	1.2	2.1	2.1	2.4	0.94	0.0000550
3	0	0.11	0.76	0.37	0.87	1	2.2	2.1	2.2	2.6	0.98	0.0000015
4	0	0.09	0.51	0.64	0.89	0.86	1.3	2.3	2.6	2.6	0.98	0.0000015
5	0	0.2	0.69	0.46	0.97	1.4	1.2	2.3	1.8	2.5	0.96	0.0000073
Mean	**0.006**	**0.136**	**0.688**	**0.524**	**0.962**	**1.072**	**1.460**	**2.160**	**2.300**	**2.580**		
Rank	*10*	*9*	*7*	*8*	*6*	*5*	*4*	*3*	*2*	*1*		

Figure E-9. BIOMAPPER habitat model output statistics summary for the Klamath Province of California.

	n	Acres	Percent Area	
Global	23,788,141	5,290,340	87.01% *of Total Province Land Area*	
Owl Presence	21,380	4,755	0.09% *of Modeled Area*	

TOT PROV AC = 6,080,289

Marginality: 0.406
Specialisation: 1.171
Tolerance (1/S): 0.854

ENFA Results

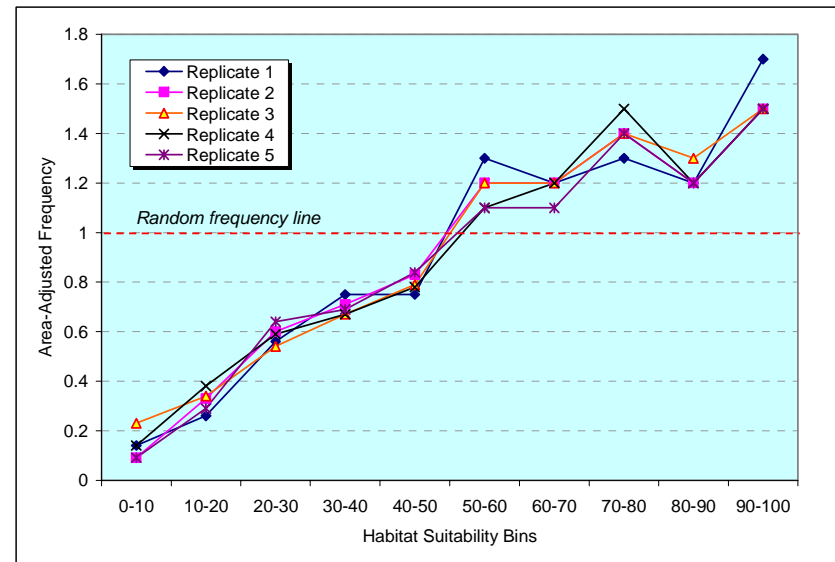| Factor 1	Factor 2	Factor 3	Factor 4	Factor 5	Factor 6
qmdcc(0.52)	qmdcc(-0.68)	struct(-0.63)	qmdcc(0.78)	qmdcc(0.79)	qmdcc(0.76)
qmd(0.51)	cc(0.59)	cc(0.57)	qmd(-0.51)	cc(-0.51)	cc(-0.52)
struct(0.47)	qmd(0.37)	bdlf(0.38)	cc(-0.34)	bdlf(0.25)	struct(-0.31)
cc(0.42)	elev(0.15)	elev(-0.35)	bdlf(0.06)	struct(-0.16)	bdlf(-0.21)
elev(-0.26)	bdlf(0.12)	qmd(0.01)	elev(0.04)	qmd(-0.14)	qmd(-0.11)
bdlf(-0.09)	struct(-0.07)	qmdcc(-0.01)	struct(0.03)	elev(0.11)	elev(-0.02)

Factors Used   **Model Indices**

Factor	Eigen Values	Explains Variation	Model Quality	Absolute Validation	Contrast Validation
1	1.843	22.40%	1.60	0.72	0.17
2	1.711	20.80%	1.40	0.71	0.15
3	1.574	19.10%	1.50	0.73	0.17
4	1.09	13.20%	1.40	0.72	0.16
5	1.077	13.10%	1.50	0.71	0.15
		88.6%			

k-fold **Cross-Validation**

REPLICATE	0-10	10-20	20-30	30-40	40-50	50-60	60-70	70-80	80-90	90-100	Rs	Prob(Rs=0)
1	0.14	0.26	0.56	0.75	0.75	1.3	1.2	1.3	1.2	1.7	0.92	0.0002000
2	0.091	0.33	0.6	0.71	0.83	1.2	1.2	1.4	1.2	1.5	0.99	0.0000001
3	0.23	0.34	0.54	0.67	0.79	1.2	1.2	1.4	1.3	1.5	0.98	0.0000015
4	0.14	0.38	0.59	0.67	0.78	1.1	1.2	1.5	1.2	1.5	0.94	0.0000550
5	0.091	0.29	0.64	0.69	0.84	1.1	1.1	1.4	1.2	1.5	0.98	0.0000015
Mean	0.138	0.320	0.586	0.698	0.798	1.180	1.180	1.400	1.220	1.540		
Rank	10	9	8	7	6	4	4	2	3	1		

Figure E-10. BIOMAPPER habitat model output statistics summary for the Coast Range Province of California.

	n	Acres	Percent Area	
Global	17,810,943	3,961,047	69.61%	of Total Province Land Area
Owl Presence	25,731	5,722	0.14%	of Modeled Area

TOT PROV AC = 5,690,268

Marginality: 0.718
Specialisation: 1.318
Tolerance (1/S): 0.759

ENFA Results

| Factor 1	Factor 2	Factor 3	Factor 4	Factor 5	Factor 6
qmdcc(0.50)	qmdcc(-0.75)	cc(-0.82)	struct(-0.69)	qmdcc(0.77)	cc(0.74)
cc(0.45)	cc(0.62)	qmdcc(0.48)	qmdcc(0.47)	cc(-0.59)	qmdcc(-0.49)
qmd(0.40)	qmd(0.25)	bdlf(-0.19)	cc(-0.46)	bdlf(0.25)	bdlf(0.35)
elev(-0.38)	bdlf(0.02)	elev(-0.18)	bdlf(-0.23)	struct(-0.07)	elev(-0.26)
bdlf(-0.37)	elev(-0.01)	qmd(-0.11)	elev(-0.18)	qmd(-0.01)	qmd(-0.14)
struct(0.33)	struct(0.00)	struct(0.10)	qmd(0.11)	elev(-0.01)	struct(-0.01)

Factors Used

Factor	Eigen Values	Explains Variation
1	2.494	23.90%
2	3.347	32.10%
3	1.543	14.80%
4	1.181	11.30%
5	1.031	9.90%
		92.0%

Model Indices

Model Quality	Absolute Validation	Contrast Validation
2.00	0.72	0.28
2.10	0.73	0.28
2.00	0.71	0.27
2.00	0.73	0.28
1.90	0.73	0.28
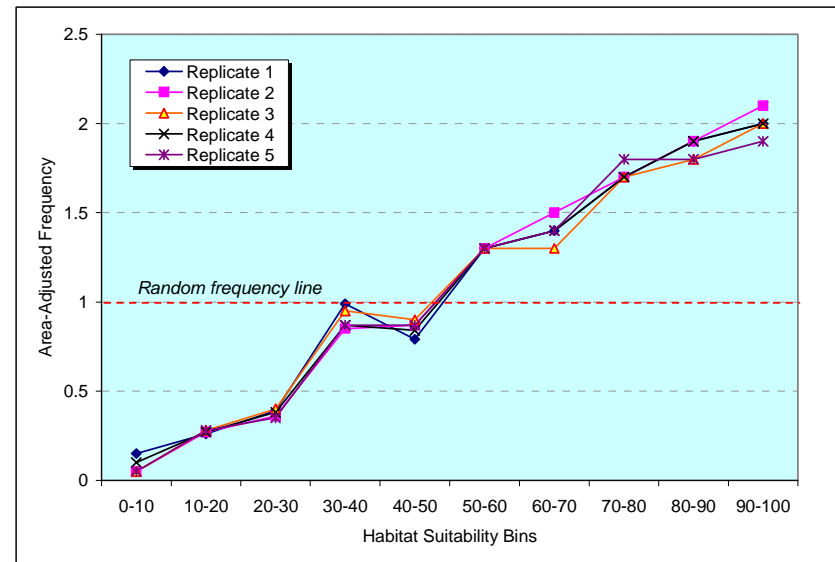
k-fold Cross-Validation

REPLICATE	0-10	10-20	20-30	30-40	40-50	50-60	60-70	70-80	80-90	90-100	Rs	Prob(Rs=0)
1	0.15	0.26	0.39	0.99	0.79	1.3	1.4	1.7	1.9	2	0.99	0.0000001
2	0.049	0.27	0.36	0.85	0.87	1.3	1.5	1.7	1.9	2.1	1	0.0000000
3	0.049	0.28	0.4	0.95	0.9	1.3	1.3	1.7	1.8	2	0.99	0.0000001
4	0.1	0.27	0.38	0.87	0.84	1.3	1.4	1.7	1.9	2	0.99	0.0000001
5	0.05	0.28	0.35	0.87	0.87	1.3	1.4	1.8	1.8	1.9	0.98	0.0000015
Mean	0.080	0.272	0.376	0.906	0.854	1.300	1.400	1.720	1.860	2.000		
Rank	10	9	8	6	7	5	4	3	2	1		

APPENDIX F - Model validation with independent datasets

A total of nineteen independent datasets were used to validate habitat suitability maps for three physiographic provinces. These datasets consisted of radio telemetry data (Dennis Rock, pers. comm. 2004) and were not used to train the habitat models. Telemetry locations were separated into datasets for each owl pair with a minimum of 100 recorded locations. A minimum convex polygon (MCP) was created for each of these datasets using the Animal Movement (v2.0) extension for ArcView Spatial Analyst (Hooge and Eichenlaub 2000). Area adjusted frequencies (AAF) were generated for each MCP by dividing the percentage of telemetry points within a bin (e.g., 0-20) by the percentage of the MCP with HS values in that bin. A Spearman rank correlation (Boyce et al. 2002) was performed for the AAF each MCP and then averaged for the area the occurred in. The average Area Spearman rank correlations were separated by province.

Area 1 – Located west of Eugene, Oregon within the Oregon Coast Range. Data was collected from 1999-2003. Seven spotted owl home ranges contained ≥100 locations.

Validation	Site	n	r_s	P
1	Cedar Creek	353	0.89	<0.001
2	Eames Creek	551	0.90	<0.001
3	Wolf Creek	219	1.00	<0.001
4	Salt Creek	452	0.82	<0.001
5	Pittenger Gall	371	0.99	<0.001
6	Luyne Creek	102	0.93	<0.001
7	Grenshaw Creek	246	0.87	<0.001
	AVG		**0.99**	**<0.001**

Area 2 – Located east of Eugene, Oregon within the Oregon Western Cascades. Data was collected from 1999-2003. Eight spotted owl home ranges contained ≥100 locations.

Validation	Site	n	r_s	P
1	Anthony Creek	302	0.43	<0.001
2	Boundary	353	0.59	<0.001
3	Drury Butte	287	0.78	<0.001
4	Brush Creek	342	0.87	<0.001
5	Eagles Rest	315	0.75	<0.001
6	Horne Butte	241	0.65	<0.001
7	Lost Creek	290	0.65	<0.001
8	Shotgun Creek	217	0.73	<0.001
	AVG		**0.93**	**<0.001**

Area 9 – Located in the southern portion of the Oregon Eastern Cascades physiographic province. Data was collected from 1999-2003. Four owl home ranges contained ≥100 locations.

Validation	Site	n	r_s	P
1	Long Prairie	116	0.36	<0.001
2	Topsy	103	0.85	<0.001
3	Miners Creek	132	0.92	<0.001
4	Edge Creek	120	0.59	<0.001
	AVG		**0.94**	**<0.001**

Overall, most correlations showed significant positive relationships with owl use locations and habitat suitability. Two sites (one in Area 2 and one in Area 9) did not show significant positive correlations, with Spearman rank correlations of 0.43 and 0.36, respectively. However, when MCPs were pooled and averaged across the areas, correlations improved significantly (Figure 1).

References

Hooge P.N. and B. Eichenlaub. 2000. Animal movement extension to ArcView, ver. 2.0. Alaska Science Center—Biological Science Office, U.S. Geological Survey, Anchorage, Alaska

National Council for Air and Stream Improvement. 2004. Rock, Dennis. Personal Communication. Amboy, WA
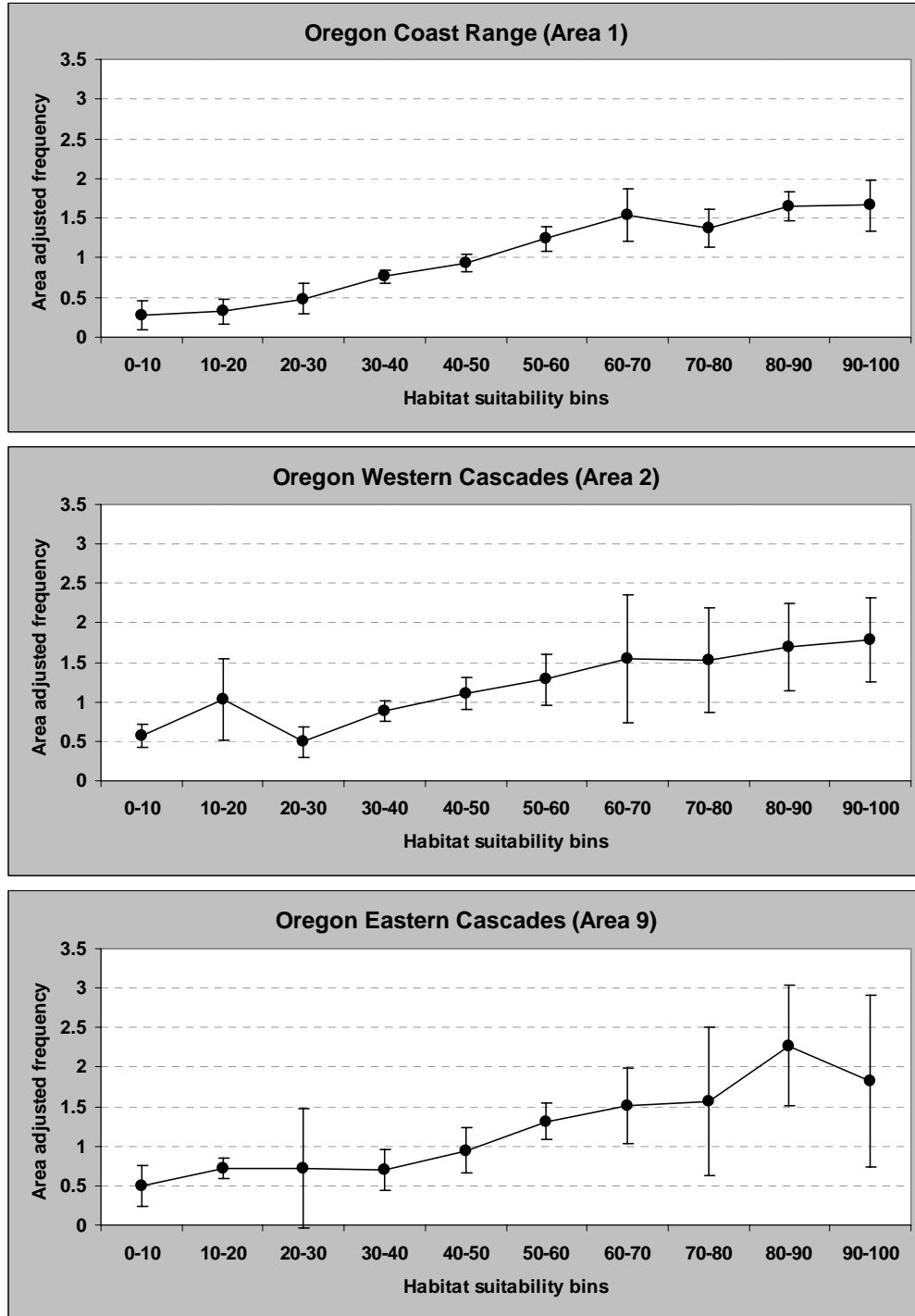
Figure 2. Spearman-rank correlations for mean (±S.D.) area adjusted frequencies (AAF) from independent owl use locations of three physiographic provinces indicate these three models predicted spotted owl use locations well.